

LESSON 1: Reducing the Amount of Plastic That Goes to a Landfill

LESSON'S CONCEPTS

- Many plastics end up in a landfill.
- Humans can reduce the number of plastic products that they buy and use in order to conserve natural resources, such as fossil fuels, and to save landfill space.

PURPOSE

Students will identify products made from plastic, learn how to distinguish different types of plastic by their plastic container code numbers, identify which types of plastics can be recycled in their community, and develop a plan to reduce the amount of plastic that goes to the landfill.

OVERVIEW

In this lesson students will:

- Identify items in the classroom that are made from plastic.
- Sort plastics by their plastic container code numbers and place a sample of the different types of plastics on a sorting sheet.
- Identify which plastics are recycled in their community.
- Apply their knowledge about the importance of conserving natural resources, such as fossil fuels from which plastic is made, by developing a plan to reduce, reuse, and recycle plastics in the classroom.

CORRELATIONS TO CALIFORNIA'S CONTENT STANDARDS AND FRAMEWORKS AND TO BENCHMARKS FOR SCIENCE LITERACY

- Students compare and classify different types of plastics and identify which ones can be recycled in their community.
 - "Properties of materials can be observed, measured, and predicted. As a basis for understanding this concept, students know: objects can be described in terms of the materials they are made of . . . and their physical properties . . ." (*Science Content Standards, Grades*

K-12; Kindergarten; Physical Sciences, Standard 1a)

- "Through science and technology, a wide variety of materials that do not appear in nature at all have become available, ranging from steel to nylon to liquid crystals." (*Benchmarks for Science Literacy, page 188*)
- "An awareness of recycling, both in nature and in human societies, may play a helpful role in the development of children's thinking." (*Benchmarks for Science Literacy, page 119*)
- "To participate effectively in society, students need to: Develop personal skills . . . group interaction skills (and) . . . social and political participation skills." (*History-Social Science Framework, page 24*)
- Students classify plastics according to their plastic container code numbers.
 - "Students sort and classify objects." (*Mathematics Content Standards for California Public Schools, Kindergarten Through Grade Twelve, page 2*)
- Students describe items in their homes that are made from plastics and identify those which could be reused, recycled, or reduced in usage.
 - "Students listen and respond to oral communication. They speak in clear and coherent sentences." (*English-Language Arts Content Standards for California Public Schools, Kindergarten Through Grade Twelve, page 5*)

SCIENTIFIC THINKING PROCESSES

observing, communicating, comparing, classifying, relating, applying

TIME

30 minutes to prepare for the lesson; 45–60 minutes to implement the lesson

VOCABULARY

solid waste, petroleum, petroleum products, plastic, resin

PREPARATION

- 1. Read the “Background Information for the Teacher” at the end of this lesson.
- 2. Ask students to bring several rinsed out plastic containers, including a soda bottle or gallon milk jug. Check to see what containers have been brought in; then collect any additional containers you might need so that each pair of students will have code 1 and code 2 plastics (the codes are usually stamped on the bottom of the container). Also, collect plastic bags with the code 4 and polystyrene cups with the code 6.
- 3. Make a copy of the sorting sheet, “I Can Sort Plastics,” for each pair of students, (page 58). Ideally, obtain heavy-weight paper that has been used on one side on which to copy the sorting sheet.
- 4. Duplicate the handout, “Plastics Coding System,” to send home with students (page 59).
- 5. Find out what types of plastics are recycled in your community.

MATERIALS

- Piece of butcher paper on which to record a list

Note: See “Note” in “Procedure,” section “C,” for an alternate way to do this activity.

- A variety of plastic containers with coded numbers (See “Preparation” step “2.”)
- A sorting sheet, “I Can Sort Plastics,” for each pair of students
- Scissors
- Stapler, tape, and/or nontoxic glue
- A copy of “Plastics Coding System” for each student

PRE-ACTIVITY QUESTIONS

- A. Have each student locate in the classroom and bring to the middle of the classroom

floor one or two items made from plastic. Cover up the items. Ask students to look around the room. What is left? *Some plastic items, such as light switches, chairs, computer parts; and nonplastic items, such as the chalkboard, windows, the door, bookshelves, books.*

Note: If you do not want students to bring items to the middle of the class, students could write the words of the different items on pieces of cardboard, and these could be placed in the middle of the classroom. However, the impact will not be as great as when students see the items missing from the classroom.

- B. Have students help you make on a piece of butcher paper a list of the plastic items that students selected.
- C. Discuss with students:
 - Are there more plastic items in the classroom than nonplastic items?
 - Of the items made from plastic, which look as if they will be used once and then thrown away into the landfill? These will become solid waste.
 - Of the items made from plastic, which look as if they will be used once and placed in a recycling bin?
 - Of the items made from plastic, which look as if they will be used more than once? Used many times? Will last for a long time?
- D. Help students to identify additional items made from plastic and record the names of these on a piece of butcher paper. For example: crayons, plastic markers, chairs, doormats, desktops, countertops, telephone, computer parts, white boards, anything laminated, plastic toys.
- E. Have students return all the plastic products to their original places.

PROCEDURE

In this activity, students learn that plastics are made from petroleum. One way to save petroleum is by reducing the amount of plastic we use, reusing plastic items, and recycling plastics. To identify those items that can be recycled, students will learn how to sort plastics by their plastic container code numbers. Unfortunately, many types of plastic are not being recycled because there are not enough companies that make products from recycled plastic, which is due in part to the difficulty of separating different types of plastic resin.

Note: If you do not want students to complete their own plastic container sorting sheets, this activity can be done as a class using large sorting circles, with each circle labeled with a plastic container code number. As an alternate activity, students can design a bulletin board or poster on which to display plastics by their plastic container code numbers. On the same poster they could also identify those plastics that can be recycled in their community.

- A. Discuss with students how our finite crude oil (a fossil fuel) reserves can be made to last longer. Remind students that plastic is made from petroleum, which is made from crude oil. *By conserving crude oil and using fewer products, reusing the products, and recycling items, such as plastics, that are made from crude oil.* (In California, it is a state law that used motor oil and used oil filters must be recycled at designated used oil collection facilities.)

Note: Information and lessons on recycling used oil are provided in the K-3 Module, Unit 5, and the 4-6 Module, Unit 4.

- B. Tell students that people can recycle plastics so less crude oil will be necessary to make new products from plastics. Explain that there are different types of plastic containers and bags, most of which are coded with a number. The number is usually embossed or printed on the bottom of the container or bag, and it identifies the type of resin from which the plastic container or bag was made. Because the different resins have different chemical compositions, they cannot be recycled together. Therefore, recycling companies separate the plastics into categories, based on their resin number. In many communities, residents and businesses are able to recycle only certain types of plastics,

based on the available market. In the next activity, students will learn more about identifying different types of plastics that are recycled in their community. Do the following:

- Have students work in pairs.
- Provide a variety of plastic containers and pieces of plastic bags with different plastic container code numbers.
- Provide an “I Can Sort Plastics” sheet for each pair of students.
- Help students cut out the plastic container code number from 1, 2, 4, and 6 types of plastic.
- Help students staple, tape, or glue each type of plastic in the appropriate place on their sorting sheets.
- Share with students what plastics are recycled in their community. Have students mark on their sheets those plastics that can be recycled in their community.
- Discuss the differences that students see and feel concerning each type of plastic.
- Once the sorting sheets are completed, some of these sheets can be mounted on a bulletin board and others can be taken home.

DISCUSSION/QUESTIONS

- A. Discuss with students what should be done with the remains of the plastic containers and bags that were not used on the sorting sheet. *Some can be reused or recycled; others will be solid waste and will need to be placed in a landfill.*
- B. Ask students to review the list of items made from plastic and to determine whether they want to make any changes to the list. Discuss whether any items should be removed or added to the list and have students give their reasons.
- C. Discuss with students:
 - What is plastic made from? *Petroleum.* (Students might not know that plastics are also made from natural gas.)
 - What is petroleum made from? *Crude oil.*
 - What category of natural resources is crude oil? *Fossil fuels, which are energy sources.*

- Is there an unlimited amount of petroleum for us to use? *No*. If students say yes, explain to them that crude oil comes from ocean plants that lived millions of years ago. These plants died, and through time and the pressure from layers of rock that trapped the plants, crude oil was formed. There is only a certain amount of oil in the ground that is presently easy to get. Petroleum is made from crude oil and is used to make many items, including gasoline, motor oil, and plastics.
- How can we make the amount of petroleum that is left last a long time? *Use only what you need; don't waste it; recycle it if it can be recycled in your community.*
- What other natural resources were used to make things in this classroom? *Plants, minerals.*
- What can we use instead of disposable (those that will be landfilled after one use) plastic? *Use the types of plastic that can be used many times; use items made from materials that can be reused or recycled.*
- How do our personal choices of what we buy and use impact the amount of solid waste that ends up in a landfill?

APPLICATION

- A. Provide a copy of "Plastics Coding System" to each student. Ask them to circle or color those plastics that are recycled in their community. Note that often only plastics with

Picture intentionally deleted.

Students in Betsy Weiss's kindergarten and first-grade class at Paden Elementary School reuse discarded plastic to make useful items.

the resin code 1 and the clear plastic 2 are recycled. Then ask them to take these sheets home to share with their parents.

Homework Assignment: Ask students to list at least ten items in their homes that are made from plastic and to write the plastic container code number for each of these plastics.

- B. The following day, ask students to share their lists and add to the list started at the beginning of the lesson.
- Have students help you check off those items that they can recycle.
 - Have students circle those items they can reuse.
 - Ask which items will become solid waste and will need to be placed in a landfill.
 - Have students underline the names of those plastic items that they can use less often.
 - Ask:
 - Which items can be kept from going to the landfill if we use fewer of them?
 - How easy is it to use less plastic in our lives?

Project Idea: Have students develop a plan to reduce, reuse, and recycle plastics in the classroom.

- C. Ask students to write a sentence or two in their journals about what they have learned in this lesson. They can also draw a picture. Have them share their journal entries in small groups. Check each student's writing.
- D. Find out and teach students (or ask a student to find out and report to the class) how to prepare plastic containers for recycling in your community (e.g., separate by code, rinse with water, step on container to compact it before placing it in the curbside recycling bin).
- E. Ask students to design another use for discarded plastic containers and other items.
- F. Have students share with their classmates what they have made.

EXTENSION

Encourage students to conduct research to find out what other products are made from plastic or from petroleum.

RESOURCES

Videos

The Adventures of Wayan and the 3 R's. Distributed by The Video Project, n.d. (15 minutes).

Through the actions of Wayan, a six-year-old native of the Island of Bali, and a shadow puppet show, viewers are introduced to the 3 R's. Children are shown picking up plastic litter and encouraging their community to reuse and recycle plastics. Then the children make props out of reused plastic for a parade.

Bottom of the Barrel. 3-2-1 Contact series. Pleasantville, N.Y.: Sunburst/Communications, 1993 (30 minutes).

Describes how oil is used to create plastics, heat buildings, fuel cars, and provide energy for industry. Explains that pollution can result when using and transporting oil.

Oil and Its Products. Produced by Wolfgang Bayer, 1979. New York: BFA Educational Media (distributor) (14 minutes).

Explains how the discovery of oil has affected manufacturing, transportation, and lifestyles. Describes how oil is formed and how it is located, mined, and refined. Introduces some environmental problems created by oil.

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Books

Brooks, Felicity. *How Things Are Made*. Finding Out About series. Tulsa, Okla.: EDC Publishing, 1989.

Explains from what natural resources things are made. Contains illustrations and descriptions of how some items are made. These include leather shoes, clay pottery, clothing, paper, glass bottles, cans, plastic blocks, and soap.

Brown, Laurie Krasny, and Marc Brown. *Dinosaurs to the Rescue! A Guide to Protecting Our Planet*. New York: Little, Brown, and Company, 1992.

Dinosaur characters describe what students can do to conserve natural resources and reduce, reuse, and recycle items. Includes a section that discusses plastics.

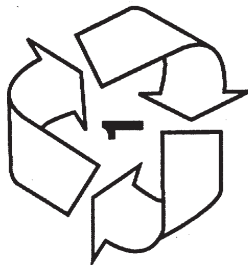
Web site

For information on plastics, visit the Web site for the Plastics Marketing Guide at: www.ci-wmb.ca.gov/mrt/mrktersch/mktguides/plastic.htm.

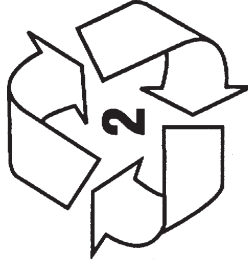
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Children look at the bottom of plastic containers for the resin code and separate the plastics that can be recycled in their community. The photographs were taken at the Solar Community Housing Association, Homestead CO-OP.

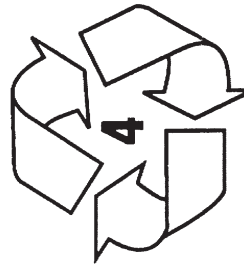
Student's Page
I CAN SORT PLASTICS



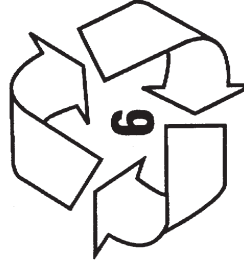
PETE



HDPE



LDPE



Polystyrene

I can sort _____ by their plastic container code numbers.

PLASTICS CODING SYSTEM

To help consumers identify more easily the different types of plastic, a numbered coding system has been developed. You can find these plastic container code numbers stamped on the bottom of containers and other plastic items or printed on plastic bags. Number 1 and 2 types of plastics are the most commonly recycled.



PETE (polyethylene terephthalate): Plastic is soft, generally clear. This plastic is used for food and beverage containers, such as soda bottles, cooking oil bottles, and peanut butter jars.



HDPE (high-density polyethylene): Plastic is translucent or white or colored. This plastic is used for milk, water, and juice bottles; bleach and detergent bottles; margarine tubs; and some grocery bags.



PVC VINYL (polyvinyl chloride): Color of plastic varies. This plastic is used in glass cleaner bottles, some cooking oil containers, and some detergent powders. (PVC has properties of good chemical resistance, which is important for holding household detergents and other harsh materials.)



LDPE (low-density polyethylene): Color varies. This plastic is used in food packaging, shrink-wrap, carry-out bags, and heavy-duty bags.



PP (polypropylene): Color of plastic varies. This plastic is used in butter and margarine tubs, yogurt containers, screw-on caps, and drinking straws.



PS (polystyrene): Plastic may be clear, hard, or in foam form. This plastic is used in cutlery and plates, foam coffee cups, egg cartons, meat trays, and yogurt cups.



OTHER: Color varies. Containers made of more than one resin type. This plastic is used in squeezable syrup and condiment bottles and some microwave food trays.

Definitions adapted from National Polystyrene Recycling Company, *How-to-Recycle Polystyrene*, 25 Tri-State International, Lincolnshire, IL 60069; (707) 945-2139.

BACKGROUND INFORMATION FOR THE TEACHER

Note: It is recommended that students complete Unit 1, “Conserving Natural Resources,” in the K–3 Module, to provide them with background for this lesson and other lessons in this unit.

Reducing the number of items people buy and use prevents waste from being generated in the first place. Many people recycle aluminum, paper, glass, and plastic, but recycling still requires the handling and transporting of materials and the remanufacturing steps which consume energy. Reducing and reusing products conserves natural resources and energy, reduces waste management costs, reduces pollution, and encourages innovation.

This lesson focuses on plastics, because many people believe that once they place plastics in a recycling bin the plastics will be recycled into other useful products. Unfortunately, the market for recycled plastics is small and has not been growing steadily. Most plastics (approximately 95 percent) are not recycled and are generally not recyclable at this time. Those plastics that are recycled are often shipped overseas for recycling.¹

Fortunately, in California, as a result of the State’s bottle and can recycling program, three of every five soda bottles (PETE) are being recycled. These plastic soda bottles are chopped up, melted, and molded into new products, such as bottles, fibers, paint brushes, stuffing for cushions and teddy bears, and linings of jackets.

In most recycling processes, the plastics must be sorted according to color and type of plastic before they are cleaned and reprocessed. The various types of rigid plastic packaging containers are coded with a number to indicate the type of resin from which they were made. This code number is embossed at the bottom of each container. Plastics with codes 1 and 2 are commonly recycled, because they are present in large quantities and have more markets available for them. At this time only PETE bottles and unpigmented (clear) HDPE bottles are generally recyclable. In 1996 the recovery rates for specific types of plastic containers were ap-

proximately 23 percent for HDPE containers and 36 percent for PETE containers.²

The CIWMB has estimated that only 3.5 percent of all plastics was diverted from landfills in 1995. The very small percent is primarily because there are not enough companies that make products from recycled plastic, which is due in part to the difficulty of separating different types of plastic resin.

Note: In this lesson students use the resin identification code developed by the Society of Plastic Industries (SPI). The code is used for identification purposes and does not mean that the plastic product is recyclable. California requires that the SPI code system be used on all rigid plastic containers sold in the state.³ This plastic coding system is further described on page 59.

Most plastics today are made from petroleum and natural gas, although the very first plastics were made from cornstarch. Plastics are made by linking together small single chemical units called monomers in repetition to build one large molecule called a polymer. The plastic polymers are made from hydrogen and carbon elements in combination with small amounts of oxygen, nitrogen, and other organic and inorganic compounds. When rearranged chemically, they produce a solid resin. The resins are used to make hundreds of different plastics.

Plastics are lightweight, durable, waterproof, easily molded, and relatively inexpensive to produce. Thus, they are used extensively in packaging. However, the same characteristics which make plastic an attractive packaging material also make it a special problem in the waste stream. Though lightweight, plastic is bulky and difficult to compact for shipping or to bury in landfills. Also, plastic is not biodegradable. Photodegradable plastics may break down into smaller pieces when exposed to enough sunlight but will never really disappear.

Plastics, like all other forms of garbage, consume

¹Written communication from Mark Murray, Executive Director, Californians Against Waste Foundation, October 12, 1998.

²Written communication with Michael Leao, Integrated Waste Management Specialist, Market Analysis and Services Section, California Integrated Waste Management Board, November 4, 1998.

³Written communication from Edgar Rojas, Waste Management Specialist, Secondary Materials and Technology Section, Waste Prevention and Market Development Division, California Integrated Waste Management Board, November 6, 1998.

valuable space in landfills. Although plastics take up only about 7 percent of landfill space by weight, they use between 10 and 20 percent by volume. Plastics are the fastest growing segment of the waste stream.

One way that everyone can reduce the amount of waste that goes to a landfill is by purchasing fewer plastic products that cannot be reused or recycled. Of the plastics that people already have, reusing (if safe to do so) should be a priority.

While society has become dependent on fossil fuels in the last 100 years for everything from transportation to the generation of electricity, to the manufacturing of plastics, and even to the production of fertilizer for much of the food consumed, fossil fuels are finite resources and also represent the single greatest contributor to pollution in society. Gasoline and diesel fuels for transportation represent the single greatest source of air pollution. Plastic is the fastest growing material taking up space in landfills, and because it is not biodegradable, it represents a permanent kind of litter. Oil spills on the land and in the water poison wildlife and pollute habitats, the by-products of petroleum often become hazardous waste, and pesticides and fertilizer contaminate farmland and groundwater.⁴ Therefore, reducing the amount of plastic that society uses conserves natural resources, including fossil fuels, and helps to decrease pollution.

Note: Additional information about plastics

⁴Written communication from Mark Murray, Executive Director, Californians Against Waste Foundation, October 12, 1998.

is included on the Web site listed in the “Resources” section in this lesson; in the “Background Information for the Teacher” in the 4–6 Module, Unit 2, Lesson 6; and in “Appendix C-VIII, Plastics,” of this curricular guide.



At a recycling center, recyclable plastics are separated by their plastic resin number and then baled. Then the bales are transported to a manufacturing plant, where new materials from these plastics are made.

NOTES